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SOME ASPECTS OF THE DEVELOPMENT OF COMPARATIVE PSYCHOLOGY.

IT is probably most satisfactory in every way, if an address is to be general, that it shall have its foundation in the line of research which has most engaged the author for a number of years past. In harmony with this principle it was open to me to choose either some subject bearing on the anatomy and physiology of the nervous system, or one dealing with animal intelligence. To have treated the former in a way satisfactory to myself would have implied considerable illustration and the use of the lantern, which could likely not be carried out without breaking in on an evening, and that was more than I cared to ask the section to do; hence the selection of 'Some Aspects of the Development of Animal Intelligence,' as the topic of this address, the treatment of which must, in the nature of the case, be incomplete.

It is no doubt true that man is more dependent than any other animal on his environment, if we restrict that term to the material world about us, but the very expression 'Every man is the product of his age' conveys the truth that the greatest genius can get only so far beyond the average thought of his time. As Darwin long ago pointed out, the most important factor in man's environment is man himself. One has scarcely emerged from infancy before the accumulated forces of the ages in human traditions and knowledge begin to mold the developing human being, and determine what he shall be. So that, be as independent and original as any one may,

he is still in a sense a product of his environment. Of anything analogous to this among the lower animals there is little, consequently in taking account of the state of comparative psychology as it is to-day, and the steps by which it has been brought to its present development, one can not for a moment lose sight of the general trend of thought and the whole sum of the forces that we term environment. If it be a fact, as it is, that men to-day regard animals in a wholly different light from that of the middle ages and long after, it is because our general philosophy of life and our point of view have greatly changed.

Art is in an especial way the reflection of the thought and feeling of the time, and one cannot but know the indifference with which the old masters treated nature and, in most instances, especially animals, which were with them simply objects to fill in a scene either in the foreground or more frequently the background. Man was with them, as with the masses of the people, the center of this mundane universe; and all things had to be represented as correspondingly subordinated to him. It was only comparatively recently that animals were painted simply because they were animals and not the mere servants or playthings of man. It is impossible to conceive of a Landseer in the age of Dante, and one is not greatly surprised that even so eminent a philosopher as Descartes should have regarded animals merely as automata. Not a few in this room can remember the time when with the masses the attitude toward the dog might be summed up in the question, What good is he? The idea that a dog might be a creature worthy of serious study with a view of ascertaining his place in the psychological scale certainly did not enter into the minds of men generally prior to Darwin. But that great transformer, the doctrine of organic evolution, has wrought wonders for psychology as well as biology. When man conceived of the world as developing, rather than as completed, the whole attitude of the reflecting animal man was changed.

It is absolutely impossible to understand the rapidity of the progress of comparative psychology, or even the change of front, within so short a period as twenty years, without bearing in mind this cardinal fact. How truly incomprehensible to most scientists must have been even fifty years ago, such a problem as that which has attracted the attention of some of the best biologists and psychologists of late, namely, the degree to which consciousness extends back and down into the lower strata of the animal kingdom. Men are now even asking why we should deny all glimmerings of consciousness to plants—whether there is not a nexus between the animate and the inanimate of a kind more intimate than we have supposed. After men began to concede that animals were more than mere living machines worked by their senses—if they even gave enough attention to the subject to get that far—it was some time before intelligent people got beyond 'instinct,' the rough-and-ready cant phrase with which to place an animal in a classification that separated it immeasurably from man. People hardly conceived of man as a creature with as many instincts as the brutes. Rapidly, however, of late have the masses begun to realize that not instinct alone, but intelligence, must be invoked to explain animals. As a natural consequence of this change—this preparation of the soil of the human mind to receive new ideas—there came a wave of enthusiasm which led some of those who were naturally lovers of animals, and also serious students of the nature of their inner life, to go too far—to attempt to explain the animal too fully by the man, to read into him all that characterized the creature of the highest intelligence. However, this is,

on the whole, scarcely to be regretted, for interest was through this sympathetic bond awakened, and prepared the way for that critical investigation of animal psychology which at an earlier period would have been premature.

Naturalists at a time prior to what may be termed the laboratory period, had noted the habits of animals with loving interest, but had not subjected them to a very critical analysis, and certainly had scarcely dreamed of correlating the mental life of even the highest groups of animals with that of man. Darwin had set the example of investigating the mental life of animals and of man by the same method of close observation. A study of his dog and a study of his child were to him of equal interest scientifically, and his records remain among the most valuable of their kind to this day.

Sir John Lubbock soon followed with admirable studies of insects. Huxley remained the critic, and his attitude in regard to animal intelligence is one of the features of that great man's mental character not readily understood. To think that so pronounced an evolutionist should have held views not greatly different from those of Descartes is truly surprising. Lubbock had worthy fellow workers in McCook, Forel, the Peckhams and others. Probably no man did more, in Great Britain at all events, to stimulate the interest not only of scientists, but of that large body of people who read to a greater or less extent the more popular of the scientific journals, than Romanes. He was in a position to devote much time to the subject, and his numerous letters and the replies they called forth in *Nature* have been among the most telling influences of our own time in advancing this subject. He has embodied his views in works, that in spite of all the destructive criticism of the last half dozen years remain valuable both as storehouses of fact and as examples of helpful critical analysis.

Within at the most ten years another great change has taken place. The biologists began to be more accurate, systematic and comparative in their observations; and, most important of all, a different class of thinkers entered the field. If the biologists can be compared to the spearmen or the axemen of the army, the psychologists are the bowmen. They brought to the task, at all events, more skill in mental analysis and, perhaps, a clearer comprehension of the problems to be solved. They were, moreover, better prepared to correlate the data of animal and human psychology and find what was common to both, as well as draw sharp lines of distinction, if, indeed, such lines can be drawn. If, on the one hand, the naturalists had been spasmodic, unsystematic and rather loose in their contributions and superficial in their analyses, the psychologists showed a tendency to substitute words and definitions for realities. Armchair animal psychology has no doubt been evolved from insufficient data—an affair of words rather than of things—nevertheless, great good has resulted for all, as we have been brought to what may be termed the experimental and critical age of comparative psychology.

It was most fortunate that, as successor to Romanes in Great Britain, the subject should have been taken up by a man so thoroughly prepared for his task as Lloyd Morgan, who is at once a biologist, a psychologist and a master of the pen. His works, in spite of the critical acumen they show, can be read by any one with a moderate knowledge of biology and a sympathy with the subject of animal intelligence. And that has given them a wide circulation, a most important matter for the education of large numbers of persons to broader and truer views of the relations of man and his fellow creatures. This is

surely of the utmost importance, if we are to look to a right mental attitude as of more to man than food and raiment.

Still later we see a rise within a very few years of a class of investigators that I presume would prefer to be called the experimental school, but whom I shall designate the laboratory school and the individuals the laborators, for I do not grant that they were the first experimenters. Their researches have practically all been such as can be readily carried out in the laboratory, a fact which explains at once, to a large extent, their excellencies and their defects, especially the latter. This school has, on the whole, been destructive. If it has, on the one hand, brought few bricks to the pile, it has, on the other, boldly attempted to overturn some edifices that were relatively of ancient date and regarded by many with considerable respect. The most extreme representatives of this school deny to animals, not only reasoning and every form of intelligence proper, but even imitation and memory. The whole psychic life of animals not to be explained by instinct was for them the result of the operation of the law of association of ideas; all else was illusion and delusion; previous workers were regarded as prejudiced in favor of animals; they were adjudged to have written as if they held a brief for animals as creatures that mentally were very like man, differing not so much in qualities as in the degree to which they were developed.

All this is wrong, utterly wrong, according to this very modern school, and claiming that anecdotes were rather misleading than helpful, that observations were of little value at the best, it was maintained that there had really, up till then, been no experiments worthy of the name, and that now, for the first time, was there something to be presented on which reliance might be placed, in spite of the fact that some, at all events, of the experimenters had neither biological knowledge nor special experience of any kind with animals, and were plainly prejudiced at the outset against the views that the common sense of mankind, as well as the consensus of opinion among naturalists, had held to be worthy of consideration. One of this school, perhaps to be considered the leader, claimed that with his method one only needed 'a pair of eyes.' This experimenter placed cats in cages twenty inches long, fifteen broad and twelve high, and because they did not, under the stimulus of hunger, speedily manipulate certain mechanisms successfully he, on this and similar evidence, employing also dogs and other animals, proceeded to demolish in very summary fashion the fundamental conclusions of hosts of observers who had occupied as many years in their tasks as he had spent weeks. Some of these conclusions seemed to be absolutely against common sense. Here we had, indeed, a violent reaction against that excess of credulity which it must be confessed had existed, and it again was the natural reaction against that indifference to animals which had characterized preceding ages.

As the experimental methods of the laborators are now attracting so much attention, it will be worth while to examine them a little more fully. I elsewhere criticized, some four years ago, the methods and conclusions of the chief agnostic of this school, Dr. Thorndike, and I see now no reason to change the opinions I then expressed. Indeed, since that time the experience, and I may add the failures of others working along the same lines, have only strengthened the force of my convictions.

Mr. L. T. Hobhouse made a number of experiments on the dog, the cat, the monkey, the elephant and the otter. In the main these tests were carried out under conditions somewhat more natural than those of the experimenters of the school

in question, but still they do not differ sufficiently to free them from the force of the objections which may be urged against all such ways of determining the nature of animal intelligence. Nevertheless, Mr. Hobhouse, using similar methods, came to very different conclusions from Dr. Thorndike, so that it would appear that something more than 'a pair of eyes' is necessary for the solution of the problems of animal psychology. Mr. Hobhouse, from all his experiments and a critical examination of those of others, together with the weighing of the evidence afforded by the most extended and accurate series of consecutive observations on mammals available, came to the conclusion that 'on their own lines and in their own way, some of the more understood mammals have powers equivalent to those of the ape.' He also in criticism of the experimental method says, 'so a dog may show not merely highly developed hunting instincts, but real cleverness in the adaptation of past experience when it is a question of catching a hare, but he may be also an intolerable dullard about opening a box.' Herein lies a great truth which the experimenters have failed in general to note. No animal and no man is equal to his fellows in all respects, and we know that some very able men, some men of undoubted genius, are exceedingly slow in certain directions.

To test an animal's intelligence by mechanisms seems to be about on a par with gauging the nature of a man's intellect by certain 'puzzles' in which, as is well known, many able men are, indeed, 'intolerable dullards.' A set of experiments better adapted for the examination of the intelligence of the group in question, white rats, was that of Mr. Small. He used a maze, which was so arranged that when the animal secured the food that was put in the central portion, he was free from the maze and could return to his cage. The shortest path to the food was 105 feet, and there were 27 corners to be turned. It is a very noteworthy fact that when monkeys were tried in a similar maze they did no better than the rats, in fact scarcely as well. But how fallacious it would be to conclude that the rat's intelligence is equal to that of the monkey. However, Mr. Small seems to have been a somewhat cautious investigator, and his work, including observations systematically carried out on the psychic development of young white rats—which he has been good enough to say was suggested by my own series on our domestic mammals and birds—his experiments with the white rat and his discerning criticism of the work of others, had not a little advanced the subject of animal psychology.

In quite another class and altogether less open to criticism are certain experiments made by Mr. Hobhouse. He ascertained how a dog, left upstairs in a building, would get to his master who called him from outside. While some of the laboratories have almost wholly ignored the individuality of animals, this criticism does not apply to Mr. Hobhouse. As this writer seems to me to have taken, on the whole, about the broadest, safest and most helpful views of animal intelligence, I feel justified, even in so general a treatment of the subject as the occasion permits, in calling further attention to them. Passing by his discussion of instinct for the present, after pointing out that Dr. Thorndike's experiments with cats, dogs and chickens were 'quite outside the range of the animal's ordinary experience,' he says, 'What Mr. Thorndike's experiments prove so far is not that cats and dogs are invariably educated by the association process, that is by habituation alone, but on the contrary that at least some cats and dogs conform in at least one point to the method of acquisition by concrete

experience—they learn in a very few instances.'

Mr. Hobhouse was one of the first to recognize clearly, though I do not say adequately, that the success of the animal in certain situations depends largely on the degree to which it can *attend* to anything in hand. It is not sufficient that an animal be stimulated, as by hunger and the sight of food—to instance a favorite stimulus used by the laborators—the animals must, if it would succeed in certain complicated situations, be able to exercise an inhibitory influence and direct its attention to the essential points in the solution of a problem, and in this respect not only do groups but individuals differ greatly. Speaking generally, the poodle has the power of attention above every other breed of dogs, so far as the learning of tricks is concerned, yet in the hunting field the pointer or setter is incomparably his superior, even in this matter of attention. But there is much in Mr. Hobhouse's generalization, 'that an animal can shift its attention to this or that object, or change within the sphere of perception, but it apparently can not follow out the structure of any complex object with any minuteness and accuracy,' and I would add that it is just here that man is so far in advance of the animal and some individuals, especially among men, superior to others.

The experimental examination of this point, so far as animals are concerned, offers an inviting and possibly fruitful field. Mr. Hobhouse found the Rhesus monkey less attentive than his dog, and not more so than the cat. But attention can be cultivated, as was shown by the improvement of this writer's dog Jack. Both the dog and the cat, he tells us, showed a general appreciation of what was to be done, for they became excited when preparations were made for a fresh experiment, even if it was of a new kind. Speaking of another dog, Mr. Hobhouse says: 'but apparently she was guided by what in the human being we should call common sense,' an opinion which of itself suffices to show that though conservative, he does not belong to the extreme agnostic school of comparative psychology. On p. 222 of his book, Mr. Hobhouse presents the following summary: "On the whole, then, it would seem that animals are influenced by similarity of relations. Not that they dissect out the common element which constitutes a class identity; they have not solved the problem which has baffled logicians; it is rather that they have a concrete perception of the man or animal, house or locality, with which they are familiar; that such an object contains many objects in various relations, and that when they meet another object, similar in general character, *i. e.*, really in its constitutive relations to the first, they know how to deal with it. This implies that they have the power of grasping an object as a whole, including distinct elements which I have called concrete experience, and the power of applying this experience, which I have called practical judgment." And again, he makes the following comprehensive statement, which is worth quoting in full: "However this may be, we have some ground for thinking that the more intelligent animals have a knowledge of surrounding objects which they apply in action; that they are capable of learning to act in accordance with physical changes which they witness; that they may be influenced by the general similarities which unite individuals of the same class, and can guide their action in dealing with any object by the relation in which it stands to that which they desire. Further, evidence has been brought that in the process by which they learn, not repetition of instance, but concentration of attention is the important point. Lastly, it is suggested that in some cases they not only

merely learn to meet a given perception with a certain motor reaction, but also to combine and adapt their actions so as to effect physical changes which, as they have learned, aid them in gaining their ends."

"We have thus gone over all the points enumerated on p. 134, as descriptive of concrete experience and practical judgment, and have seen some ground for imputing each and all to the higher animals. At no point, perhaps, is the evidence conclusive, but it is to be remembered that these functions are indicated so that evidence of capacity for one is indirect evidence of capacity for another. We have, therefore, a set of independent arguments all pointing in the same direction, and it is on this convergence of evidence rather than on decisive proof at any point, that our hypothesis must rest."

But little credit has been given to animals by the laborators for inhibition or self-restraint. Their experiments were not calculated to bring this quality into bold relief—quite the contrary. Such experiments often tend to cause mental disorder, so that one is not observing the animal at its best, but at its worst. Mr. Hobhouse, however, has not wholly neglected this subject, for he remarks that "the self-restraint of the pointer is the result of severe training, but we must not regard it as the result of mere blind habit superseding blind impulse, for, as Diezel remarks, the same dog who will refrain from following a hare in his master's presence will eagerly chase it if unobserved. The impulse is not instinct, but is controlled by the knowledge of results."

This subject is another on which fruitful work might be done; and here again one finds the greatest difference between individual animals as also between individual men. The difficulties in carrying out experiments on monkeys, because of their restlessness, are great, and Dr. Thorndike and Mr. Kinnaman deserve great credit for their perseverance, though I must say I should not have expected the most satisfactory results from some of their tests. Dr. Thorndike points out that the monkeys represent progress in mental development from the generalized mammalian type towards man in several directions, as in their sensory and motor equipment, but he is inclined, in accordance with his views of animal intelligence and psychology generally, to make all things pivot on the association process. He says, "Let us not wonder at the comparative absence of free ideas in the monkeys, much less at the absence of inferences or concepts. Let us not wonder that the only demonstrable intellectual advance of the monkeys over the mammals in general is the change from the few narrowly confined practical associations to an amplitude of all sorts, for that may turn out to be at the bottom the only demonstrable advance of man, an advance which in connection with the brain acting with increased delicacy and irritability brings in its train the functions which mark off human mentality from that of all other animals." And in his paper on the 'Evolution of the Human Intellect,' he expresses the opinion that the "Intellectual evaluation of the race consists in the increase of the number, delicacy, complexity, prominence and speed-formation of such associations. In man this increase reaches such a point that apparently a new type of mind results which conceals the real continuity of the process."

I can not but think myself that this is only a small part, a mere chapter of the whole story, and that by believing this to be the whole we retard progress. I wish to point out, however, that there does not seem to be the same objection to the methods of the laborators when applied to lower vertebrates. Dr. Thorndike's own studies on

a fish, *Fundulus*, with a low type of brain; the investigation of Yerkes and Bosworth on the cray-fish; that of Yerkes on the turtle; those on birds by various observers; and others to which the limitations of time do not permit me to allude seem to be in the right direction; all the more as in the case of fishes, turtles and other aquatic creatures ordinary observations must, in the nature of the case, be very restricted. We should surely expect that simple association processes would play a larger part in the psychic life of such creatures than in that of mammals. But when it is urged that 'association processes' with instinct explain all, or practically all, in the mental make-up of animals, I must enter a most vigorous protest.

Mr. Kinnaman is not sure, as a consequence of his investigations on the monkey, and as Dr. Thorndike believes, that they have no 'free ideas'—to use the terminology of the latter, and expresses his views regarding the monkey and animals generally, as follows: "Whether these animals have 'free ideas' and general notions beyond the mere 'recept' and are capable of real analogical reasoning, can not be positively determined. If they do the processes certainly do not rise to the level of full reflex consciousness. Yet there is no way of knowing, because there is no certain way of having the consciousness that the animal has. But that these monkeys have often acted objectively just as human beings act when they have these mental activities is most certain. I am inclined to believe that the human and animal consciousness are not really different in kind, but only in degree; the difference in degree, however, is very great." Mr. Hobhouse believes that there come points in growth where change of degree becomes change of kind, and refers to the fact that water may become vapor or ice according to the rate of vibration of the constituent molecules. However, analogies are proverbially dangerous.

With this writer's other views on the relation of human and animal intelligence as expressed in the following words, I find myself in accord: "Human intelligence develops out of a lower form by growth in this feature of comprehension on the one hand, and articulateness on the other, by which the higher stage of animal intelligence was marked off from the lower. Mind, it is suggested, differs from mind in the degree in which these powers are developed, in the experience which it can comprehend and in the articulateness with which it can comprehend it."

A noteworthy recent contribution to our subject is the address of Professor C. S. Minot to the American Association for the Advancement of Science on, 'The Problem of Consciousness in its Biological Aspects,' from which it appears that the professed psychologists are not doing all the thinking on psychology or philosophy. His general attitude may be understood from the following passage: "We must look to biologists for the mighty generalizations to come rather than to the philosophers, because great new thoughts are generated more by the accumulation of observations than by deep meditation. To know, observe. Observe more and more and in the end you will know. A generalization is a mountain of observations; from the summit the outlook is broad; the great observers climb to the outlook while the mere thinker struggles to imagine it. The best that can be achieved by sheer thinking on the data of ordinary human experience, we have already as our glorious inheritance. The principal contribution of science to human progress is the recognition of the value of accumulating data which are found outside of ordinary human experience." Minot's cardinal principle is thus expressed: "The function of consciousness is to dislocate in time the reactions from sensations."

"Conscious inhibition is thus distinct from reflex action; the potential reaction may, however, be stored up and effect future conduct. Consciousness has a selective power manifest both in choosing from sensations received at the same time and in combining sensations received at different times. It may make synchronous impressions dysynchronous in their effects and dysynchronous impressions synchronous, which statement is but a paraphrase of the original—the function of consciousness is to dislocate in time the reactions from the sensations."

"Our eyes, ears, taste, etc., are available because they supply consciousness with data. Our nerves, muscles, bones, etc., are available because they enable consciousness to effect the needed reactions." His view of animal consciousness is thus forcibly expressed: "The conception of homology, both of structure and of function, lies at the base of all biological science, which must be and remain incomprehensible to any mind not thoroughly imbued with this conception. Unless those who are deficient in this respect can fail to understand that the evidence is overwhelming that animals have a consciousness homologous with the human consciousness, the proof is conclusive. As regards at least mammals—I think we can safely say as regards vertebrates—the proof is the whole sum of our knowledge of the structure, functions and life of these animals. As we descend the animal scale to lower animals there is no break and, therefore, no point in the descent where we can say here animal consciousness ends and animals below are without it. It seems inevitable therefore to admit that consciousness extends far down through the animal kingdom, certainly at least as far down as there are animals with sense organs, or even the most rudimentary nervous system. It is unsatisfactory to rely chiefly on the anatomical evidence for the answer to our query. We await eagerly the results from psychological experiments on the lower vertebrates. A sense organ, however, implies consciousness, and since such organs occur among cœlenterates, we are ready to assign consciousness to these animals."

"The series of considerations which we have had before us lead directly to the conclusion that the development and improvement of consciousness has been the most important, really the dominating factor in the evolution of the animal series."

Minot is of those who would not deny consciousness absolutely to even vegetable organisms, for he says: "A frank unbiased study of consciousness must convince every biologist that it is one of the fundamental phenomena of at least animal life, if not, as is quite possible, of all life."

On adjustment and communication between individuals he thus expresses himself: "It is interesting to consider the evolution of adjustment to external reality in its broadest features. In the lowest animals the range of the possible adjustment is very limited. In them not only is a variety of possible actions small, but they cover also a small period of time. In animals which have acquired a higher organism the adjustments are more complex, both because the reactions are more varied, and because they cover a longer period of time. Thus the jelly fish depends upon such food as happens to come within its reach, seizing from moment to moment that which it encounters; but the lobster pursues its food, making complicated movements in order to reach and seize it. One can trap a lobster easily; I doubt if one can trap a jelly fish at all. The next great advance is marked by the establishment of communication between individuals of the same species. About this phenomenon we know exceedingly little; the investigation of it is one of the most important duties of

the comparative physiologist. Its bionomic value is obviously great, for it allows an individual to utilize the experience of another as well as its own. We might, indeed, compare it to the addition of a new sense, so greatly does it extend the sources of information. The communication between individuals is especially characteristic of vertebrates, and in the higher members of the subkingdom it plays a great rôle in aiding the work of consciousness. In man, owing to articulate speech, the factor of communication has acquired a maximum importance. The value of language, our principal medium of communication, lies in its aiding the adjustment of the individual and the race to external reality. Human evolution is the continuance of animal evolution, and in both the dominant factor has been the increase of the resources available for consciousness.''

Professor Minot believes that consciousness is a real and dominant factor in the evolution of animals, that it affects the vital processes: ''There is, in my opinion, no possibility of avoiding the conclusion that consciousness stands in immediate causal relation with physiological processes.''

While I may not be ready forthwith to admit that Minot's dictum in regard to consciousness is perfectly satisfactory, it has been gratifying to me to find so many views similar to those which I have been myself accustomed for the past few years to elaborate in my lectures to students, expressed so clearly and vigorously in this address.

H. S. Jennings, who has worked much on the reactions of infusoria, after criticizing the conclusions of Hodge and Aikins, which he concludes go too far, refers to Minot's views. He thinks that by this writer's criterion we should clearly have to attribute consciousness to Stentor, for at times this creature inhibits reactions to stimuli, while again it reacts strongly. Jennings is not, however, satisfied with Minot's criterion, for he believes that 'Unconscious mechanisms can be constructed and, indeed, do exist, in which there is a dislocation in time between the action of an outer agent upon the machine and the reaction of the machine similar to what we find in organisms.'

I can do but scant justice to a highly critical, profound and suggestive paper by H. Heath Bawden on 'The Psychological Theory of Organic Evolution.' He passes in review the work of Binet, Cope, Loeb and others. Professor Loeb lays stress on what he terms 'associated memory,' by which he means, 'that mechanism by which a stimulus brings about not only the effects which its nature and the specific structure of the irritable organ calls for, but by which it brings about also the effects of other stimuli which formerly acted upon the organism almost or quite simultaneously with the stimulus in question.' Consciousness ceases with 'associated memory,' as in sleep, anæsthesia, etc. According to this test, Loeb fails to find consciousness in infusoria, cœlenterates and worms, and doubtfully in many higher forms. He is quite certain of consciousness only in many of the higher vertebrates. Bawden thinks Loeb errs, and while he believes that this criterion may be good for determining the *degree* of mammalian consciousness, he believes it too restricted to apply to the whole animal kingdom, much less to the plant world. Romanes held that 'consciousness was that which enables the organism to learn to make new adjustments or to modify old ones in accordance with the results of its own individual experience.' ''Purposiveness means simple adaptation of means to ends; consciousness means the ability to vary the use of means to an end. The former may be quite automatic, the latter alone must be conscious'' (Bawden).

Baldwin says, ''Consciousness is the new

thing in nature, the thing which organisms show in all cases, their latest and finest adjustment and the central fact of consciousness, its prime instrument, its selective agent, its seizing, grasping, relating, assimilating, apperceiving—in short, its accommodating element and process—is attention.''

Probably in no direction has more solid advance been made within the last ten years than in the psychology of instinct, impulse, habit and kindred subjects. Professor Lloyd Morgan's best contributions have been in this realm. In this he has been both the observer and the thinker, and his biological training has been at once a preparation for the task and a ground of confidence for the reader of his works. His 'Habit and Instinct' embodies much of the best that has been attained in that department. He, however, wisely draws on the stores of others and in these subjects the data are more abundant and reliable probably than in any other department of the whole field. The investigations of the Peckhams on insects deserve in this connection special mention. All agree that it is here that man and the animals stand on common ground. There is scarcely a prominent writer on human psychology who has not treated at greater or less length of the subject of impulse, instinct and habit. However, a great field is yet open, notwithstanding all that has been done, including such bold attempts as that of Professor Baldwin and others, to determine the sphere of these fundamental activities in the course of organic evolution in general.

The limitations of this address will not permit of extended reference to this subject, in which some of the best work of the last decade has been done. But at least a word must be said of the investigations of Professor Groos, whose books on the play of animals and play in the human being are mines of learning and full of suggestive, highly interesting and generally valuable information. Mr. H. R. Marshall has also quite recently devoted an entire work to the subject of 'Instinct and Reason.'

It seems to me that development in this subject has been retarded by an inadequate appreciation of what I conceive to be of the greatest moment: that the qualifications of the investigator are of quite as much importance as the method, probably a great deal more. Professor Groos has thus referred to the equipment of the individual who would study animals in one of their aspects: 'The author of the psychology of animal play should have in reality, not alone two but many souls within his breast.' He would have him combine with all the varied ideas and experiences of a man who has traversed the round globe, the special knowledge of the director of a zoological garden, and also that of him who has penetrated the life secrets of the forest, and who can moreover take the point of view of a student of æsthetics. If these are the qualifications for a special investigation of animal play, they are surely not less called for in the other realms of comparative psychology. However, many who are not qualified to do the highest kind of work in this department of investigation can, if they will, make contributions of accurate observations; but they must be slow to draw conclusions and have a saving modesty which can hardly be claimed as the most distinctive characteristic of the present-day investigator, but which so often caused Charles Darwin to pause.

To more than one has it seemed desirable that some correlation between the animal and the human mind should be attempted, and this could be best done by comparing the former with the human within a relatively short time after birth. Already a goodly store of material is available, but

special child study to this end is one of the needs of the hour.

SUMMARY.

The evolution of comparative psychology has followed in the main the evolution of biology and of psychology, and the general trend of human thought.

When man's mental attitude toward nature in general changed, animals also were regarded in a new light.

Until comparatively recently the contributions to the subject have been characterized by many-sidedness, but at the same time by looseness and often inaccuracy, with a tendency to undue credulity and anthropomorphism.

The 'experiments' of the laboratory school of comparative psychology have been chiefly valuable in their negative and indirect results. A large proportion of the tests used thus far have been inadequate and often positively misleading; but they have also indicated the directions in which we need not hope to succeed, and suggested more fruitful methods. These experiments have shown that under even unfavorable conditions animals may form new mental associations with surprising rapidity.

The laboratory methods have proved themselves best adapted to the study of invertebrates and the lower vertebrates.

The most fruitful work thus far done has been the observation of the development of animals from birth upward by the consecutive or (fairly) continuous method, together with such experimentation as has been carried out under freer and more natural conditions generally than those under which the laborators worked.

It is important that similar observations and experiments be made on other of our domestic animals and especially on wild animals.

In all cases the investigator should be, if possible, a man with a knowledge of animal life in general, and a special knowledge of the animals to be subjected to critical observation; and if he can combine this with a scientific acquaintance with both biology and psychology, so much the better. The sooner it is realized that the man is as important as the method, the better for the development of comparative psychology.

Much light is likely to come to comparative psychology from judicious child study, and it is important that both biologists and psychologists turn towards it and if possible work in concert in dealing with so large a field as comparative psychology.

Wesley Mills.

McGill University.

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SCIENTIFIC BOOKS.

British Museum (Natural History). Second Report on Economic Zoology. By FRED. V. THEOBALD, M.A.

The author, who is vice-principal and zoologist of the Southeastern Agricultural College, and lecturer on economic entomology to Swanley Horticultural College, in England, has carried on the whole of this work, and drawn up the report as printed. It contains a large part of the information furnished by the director, Professor E. Ray Lankester, to the board of agriculture and fisheries, between November, 1902, and November, 1903, besides the replies given by the zoological department to other correspondents in connection with economic zoology, as well as special notes and some longer papers dealing with the subject. This makes a volume of nearly 200 pages of preeminently economic literature, relating to subjects of the utmost importance to the husbandman, not only in England, but throughout the British colonies as well. It is a very creditable report, from both the practical and the scientific point of view, and exhibits on the part of both author and director a sincere desire to enlarge its usefulness. This is witnessed by a number of cases where Mr. Theobald has been able to make some personal investigations and experiments, the results of which are given and serve to add materially to the economic value of the volume. It will prove of interest to American entomologists in a number of ways, as subjects of applied entomology in British colonies overlap similar subjects of investigation in the United States. Thus the Mexican cotton-boll weevil, cotton-boll worm, American fowl tick (*Argas americanus* Packard), Mediterranean flour moth, pear midge, wooly aphis (which our British cousins term the American blight) pea weevil, hog louse, sheep scab, cabbage root-fly, larch and spruce aphis, willow scale, ox warble fly, liver fluke in sheep, rose aphis, grain weevil, and the sheep nasal fly are all of them cosmopolitan pests, and anything pertaining to them is of equally general interest, and all receive attention in this report, together with suggestions for the best means of prevention or extermination.

Mr. Theobald has been able to experiment with arsenate of lead for codling moth, and found that it is as effective in England as it is in America; besides he has found that while fruit growers can not combine Paris green, Bordeaux mixture and paraffin emulsion, they can do so with arsenate of lead substituted for Paris green, and besides combine with quassia washes, thus securing a wash that will combine two chief insecticides and a fungicide.

The introduction of beneficial lady beetles comes in for its share of attention, and there is much encouragement in reading of the inquiries that have been received from not only hop growers but fruit growers. Surely, if some of the aphis-eating lady beetles that the writer observed in the gardens about Hobart, Tasmania, a number of years ago, feeding on these insects, could be colonized in the United States, there might be considerable benefit derived from them, and there is no reason to suppose that the results would differ in England.

While not of vital importance to the American entomologist or fruit grower, it is inter-

esting to know that some of the ground beetles attack the ripening strawberries in England, precisely as do similar insects with us, and it is especially interesting to learn that good results have been obtained by sinking small 'pudding-basins' in the soil between the rows of strawberries and baiting the beetles with lights and sugar water. It is also of interest to us to know that *Byturus tomentosus* attacks the raspberry in England precisely as does its congener, *B. unicolor,* in America.

The volume gives every promise of meeting a demand among the agricultural classes for just this sort of helpful literature, but since it was received we have been surprised and pained to learn that continuance has been made impossible from the fact that the Royal Board of Agriculture has refused to grant funds for publication of future volumes.

When we recall that, for almost a quarter of a century, the late Miss Eleanor A. Ormerod carried on this work and published annually her valuable and painstaking reports, all at her own private expense, from which this board of agriculture made constant and copious abstracts, not always with too scrupulous credit, and now this same body refuses to contribute the mere pittance to enable Professor Lankester and Mr. Theobald to continue the work, we are forced to admit that our British (no, English) cousins have some characteristics that we find it hard to comprehend. However, the apple growers of the United States, Canada and Tasmania, who keep up with the times, will doubtless continue to furnish England with apples at profitable prices, and, as they jingle good British gold in their pockets, they will mentally smile at the little bigness of the Royal Board of Agriculture, which body seems inclined to further assist by a continuation of the conditions most favorable for future commercial transactions in fruit, etc., between these countries and England. F. M. Webster.

SOCIETIES AND ACADEMIES.

THE CHEMICAL SOCIETY OF WASHINGTON.

A special meeting of the Chemical Society of Washington was held on Wednesday April 6, 1904, at eight o'clock P.M. in the chemical lecture hall of the Columbian University. The meeting was addressed by Dr. Charles Baskerville, of the University of North Carolina, who after being introduced by the president spoke upon the following subjects:

Geo. F. Kunz and Charles Baskerville: 'Kunzite and its Unique Properties.'

Chas. Baskerville and L. B. Lockhart: 'Cause of Radio-activity.'

Chas. Baskerville: 'Thorium, Carolinium, Berzelium.'

The speaker exhibited specimens of kunzite and described some of its peculiar properties. In regard to the cause of radioactivity he called especial attention to the observation that all minerals which have the property of becoming phosphorescent under the action of radium rays, contain the element helium. The possibility was suggested that there is a relationship between the emanations of radioactive bodies and helium. In regard to the last subject on the program the speaker entered into greater detail, from both the historical and the experimental side of the question. He described the work which has occupied the attention of himself and a large number of assistants for the past ten years.

At the conclusion of the address some experiments were shown and specimens of radium of different degrees of activity were exhibited.

The 150th regular meeting of the Chemical Society of Washington was held Thursday evening, April 14, 1904, in the assembly hall of the Cosmos Club.

The first paper on the program, entitled 'The Feldspars—The Relation between their Composition and Certain Physical Properties,' was presented by Dr. E. T. Allen. An abstract of this paper has already been furnished Science for publication.

The second paper on the program, entitled 'Solubility of Gypsum in Solutions of Potassium Sulphate and Sodium Sulphate,' by F. K. Cameron and J. F. Breazeale, was presented by Dr. Cameron. The authors showed that at 25° C. with increasing concentration of potassium sulphate the solubility of calcium sulphate at first falls from 2.126 gms. $CaSO_4$

per liter to about 1.42 gms. $CaSO_4$ per liter in a solution containing about 15 gms. K_2SO_4 per liter, and then gradually rises to 1.585 gms. per liter in a solution containing 32 gms. K_2SO_4 per liter. This latter point is a triple point where a new solid phase syngenite ($CaSO_4 \cdot K_2SO_4 \cdot H_2O$) separates. As the concentration with respect to potassium sulphate still increases, no gypsum remains as solid phase but only syngenite, the amount of calcium sulphate in solution steadily decreasing. The solubility curves were determined, starting both with gypsum and with syngenite, good agreements being obtained. The position of the triple point was redetermined by the authors by using the procedure of van't Hoff and Wilson who had found a somewhat higher concentration with respect to calcium sulphate. The results confirm those obtained by extrapolation on the solubility curve. The solubility curve for calcium sulphate and sodium sulphate previously determined at 25° C. by Cameron and Seidell was confirmed. It is similar to the calcium sulphate, potassium sulphate curve, but there is no separation of a double salt at the temperature employed.

The last paper on the program, entitled 'Ammonium Chloride as a Reagent for Indicating Dissociation,' was presented by Dr. Peter Fireman.

In a former communication the author showed that when antimony pentachloride and ammonium chloride are heated in a sealed tube they act upon one another according to this equation:

$$3SbCl_5 + 2NH_4Cl = 3SbCl_3 + 8HCl + N_2,$$

while tin tetrachloride and titanium tetrachloride remain unchanged when similarly treated with sal ammoniac. The different behavior of the chlorides was ascribed to the fact that antimonic chloride readily dissociates on heating while the other two metallic chlorides do not.

In his new communication he gave the results of experiments by which he tested the validity of this explanation. The hypothesis was fully corroborated. He found that ferric chloride and cupric chloride which are known to dissociate behave like antimonic chloride, the reaction being:

$$3FeCl_3 + NH_4Cl = 3FeCl_2 + 4HCl + N$$

and

$$3CuCl_2 + NH_4Cl = 3CuCl + 4HCl + N,$$

while mercuric chloride, a non-dissociating halide remains unchanged like stannic chloride or titanium tetrachloride.

A. SEIDELL,
Secretary.

THE SCIENCE CLUB OF THE UNIVERSITY OF MISSISSIPPI.

THE regular monthly meeting of the club was held April 15, 1904, in the chemical lecture room. The leader for the evening, Professor R. W. Jones, presented 'Some Thoughts in Reference to the Water Supplies of Mississippi.' A brief account of the history of water analysis was given, showing that, while in earlier years stress was laid upon the mineral ingredients, to-day the emphasis is placed upon the organic and sanitary analyses. In passing, the fact was noted that the value of mineral springs had long been greatly exaggerated. The Michigan standard of the purity of drinking water was discussed by the lecturer. The speaker then called attention to some interesting and valuable results of his own analyses of water from deep wells, artesian wells and streams throughout the state. Special reference was made to the geological formations of the middle-eastern section of the state, affording four different water-horizons, each yielding water of excellent quality.

ALFRED HUME,
Secretary.

THE SCIENCE CLUB OF UNIVERSITY OF WISCONSIN.

THE sixth meeting of the club for the year was held Tuesday, March 22, in the physical lecture room of Science Hall. The first paper of the evening was by R. A. Harper on 'The Organization of the Cell as shown in Certain Mildews.' The paper discussed the development of the fruiting bodies of certain mildews from the standpoint of the structure and behavior of their nuclei in both fusing and dividing cells. A permanent polar organization of the nucleus and continuous connection of chromation and central body are found in these fungi.

The second paper, by A. H. Taylor, on 'Resonance in Aerial Systems,' was a discussion by the author of some recent advances in wireless telegraphy; it was illustrated and showed the fourfold tuning necessary for the transmission of large amounts of energy. The sender, the two aerials and the receiver were successively attuned, enough energy being transmitted several meters to light three small incandescent lamps.

VICTOR LENHER,
Secretary.

THE ELISHA MITCHELL SCIENTIFIC SOCIETY OF THE UNIVERSITY OF NORTH CAROLINA.

THE 154th meeting was held in the Physics Lecture Room, Tuesday evening, April 12. The following papers were presented:

PROFESSOR C. L. RAPER: 'The World's Production and Consumption of Coal.'

PROFESSOR H. V. WILSON: 'Grafting in Vertebrate Embryos.'

PROFESSOR R. H. WHITEHEAD: 'Protozoa in Smallpox.'

A. S. WHEELER,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

SCIENCE, NATURE AND CRITICISM.

THERE appeared in a recent number of SCIENCE a somewhat unscientifically savage attack upon William J. Long and his books by Mr. William Morton Wheeler. The attack, which was ostensibly made on scientific grounds, was speedily followed by another and more personal one, written by Mr. Frank M. Chapman, and by a third by Mr. W. F. Ganong, who, on the principle that 'any stick will do to beat a dog with,' sent in an old criticism that was first published and answered in a St. John newspaper. The first object of the present article is to examine these attacks, and see what truth underlies them.

Very obviously there are two questions here, a question of animals and a question of animus. With the latter we have nothing whatever to do, except to deplore it. The original *Atlantic* attack upon the books in question, which was quoted and commended, can hardly be regarded as scientific, so far as this means a calm, dispassionate sifting of facts and evidence; and the writers, in following their leader, have been, perhaps, too much influenced by the great Frenchman's maxim that 'among wolves one must howl a little.' But, laying all that aside, the readers of SCIENCE have undoubtedly asked, how much truth is there in these animal stories, which have not only been called in question but have been denounced as falsehoods and inventions?

I take the most incredible of all, the case of the woodcock that set his broken leg in a clay cast, which was ridiculed by Mr. Wheeler in SCIENCE of February 26. Now, forgetting all the ridicule and misrepresentation and facetiousness of the article, what evidence have we for believing the story as recorded? For myself, having seen the incident, it has passed beyond the realm of opinion or belief into the realm of fact. Nevertheless, I pass over this, and also over the strong supplementary testimony of my friend, who might be considered as partial, to submit other evidence of which there can be no reasonable doubt as to its truth or disinterestedness.

Soon after the surgery article first appeared in *The Outlook*, the editors of that magazine received a letter from a lady in Galion, Ohio, who told of finding a woodcock that had set its broken leg in a clay cast in a way precisely similar to that recorded in the article on 'Animal Surgery.' When the attack of Mr. Wheeler, in SCIENCE, was called to my attention, I wrote to the lady, asking her to send me any supplementary details of her observation and the names of any other reputable people who might know of the circumstances. Here is the result—and I have submitted all documents and letters to the editor of SCIENCE that there may be no question as to their genuineness:

My dear Dr. Long:

The circumstances in regard to the woodcock are just as my father writes (see following letter), but I send a few facts in addition to those he has given. A short time before my father shot the bird we had read that the woodcock can put its own leg into a clay cast, but this hardly seemed credible. I was cleaning the game and had cut off the legs of the woodcock before I noticed that one leg had upon it a lump of dried mud. Immediately what I had read flashed through my

mind, and I saved the leg. * * * It was exhibited by my father to several physicians in town and all admitted it to be a broken leg perfectly mended by the bird itself. Dr. C. L. Coyle and Dr. H. R. Kelley (both deceased, but both well known and reputable physicians) exhibited this curiosity, one at a meeting of Galion physicians, the other at a meeting of the Crawford County Medical Society. No one denied or doubted in any way that it was what we thought it to be. * * * (Signed) RENA REESE.

GALION, OHIO, April 4, 1904.

DR. WM. J. LONG,

Dear Sir: I have been in business in this place for the past thirty-two years. During this time I have always spent a few days yearly in hunting the different game birds in their various seasons. One day, a number of years ago, when hunting woodcock, I shot one which had evidently broken its leg above the knee joint. There was a bandage around it, composed of a hard clay-like substance, interwoven with grass or a woody fiber of some kind. The bone seemed to have been set properly and had knit perfectly. The natural swelling was nearly all gone; the bandage was loose and in my opinion would soon have dropped off.

I gave the leg, with the bandage on it, to one of our leading physicians and surgeons. He upon examining it expressed himself in a very emphatic way by saying that it was a better job than nine tenths of the surgeons could do. Dr. Coyle kept the leg at his office and later exhibited it at a convention of the physicians and surgeons of this country. After his death it was again exhibited at a meeting of the physicians of this city. Much interest was manifested in this curiosity, the like of which had never been seen by any one here, though some had read of such a thing.

(Signed) S. M. REESE.

* * * I carefully examined the specimen referred to, and can verify the statements of Miss Reese in every particular.

(Signed) F. L. BROWN, M.D.

* * * A number of years ago there was exhibited in my place of business (apothecaries) the leg of a woodcock, which had been broken, and which plainly showed, by the clay and fiber entwined about it, that it had been dressed by the bird itself. * * *

(SIGNED) L. K. REISINGER.

Here is another case from a different state. I quote from the sworn statement of Mr. David E. Smith, of Bridgeport, who until a short time ago, when the sale of game became unlawful in this state, was engaged in the business of buying and selling game birds for the market, in connection with his regular business as a gun- and locksmith.

* * * Almost eighteen years ago Mr. Thomas Finn, a member of the police force of Bridgeport and who was accustomed to hunting game birds in season, brought to me the leg of a woodcock which he had shot. About midway between the foot and knee there was a clay cast in which some small feathers of the bird and some grass had been interwoven, apparently to make it more adhesive. This cast around the leg was a little over one half inch in length and about as large as an ordinary lead pencil. This leg of the woodcock was on exhibition at my store for a long period of time.

About eight years ago Mr. George W. Hayes, a well-known sportsman of this city, brought me the leg of a woodcock he had shot, and it presented an appearance substantially the same as the one above described. I opened the clay cast * * * and found that the leg had been broken. I exhibited this leg, with the part of the cast that I had not detached, to several persons in this city.

Since then I have seen another woodcock's leg that had been cut off by another sportsman presenting the same conditions; and four years ago, in a purchase of birds for re-sale, I found that one of the woodcock had a clay cast on one of its legs similar to the other three that had come under my observation. I exhibited this leg with its clay cast in my show window for two years, and a great many persons in Bridgeport saw it.

The cast was so constructed and so attached to the leg as to preclude any theory of accidental attachment; for in each case it was uniformly attached around the leg and fashioned in a way to indicate that it was attached for a purpose, and was in each instance made more effective by the interweaving of dry grasses or small bird's feathers. * * *

(Signed) DAVID E. SMITH.

BRIDGEPORT, CONN., 23 April, 1904.

We, the undersigned, have seen in the possession of David E. Smith, on various occasions, a woodcock's leg with a clay cast surrounding the leg, presenting the appearance described in the foregoing affidavit. * * *

(Signed) WILLIAM B. TUTTLE,
JOSEPH H. SMITH,
WM. K. WOLLAN.

Personally appeared before me David E. Smith, William B. Tuttle, Joseph H. Smith and William K. Wollan, each of whom is personally known to me, and made oath to the truth of the foregoing statements.

(Signed) STILES JUDSON, JR.,
Notary Public.

Here is certainly warrant for believing not only that the woodcock sets his own broken leg, but also that the habit is more common and widespread than I supposed possible when I published my own observations. I have other letters and evidence from three different states bearing on the same question, and to the same effect; but these are probably enough. It may safely be left to the readers of SCIENCE to determine whether or not my story of the woodcock in 'A Little Brother to the Bear' is carried out, even to the smallest detail, by this disinterested evidence.

The second attack, by Mr. Chapman, is an extraordinary one for a man to make in the name of science. Starting with the assumption that, in the woodcock article and in all my books, I am falsifying and misrepresenting, he endeavors to account for it on the ground of personal characteristics. With calm and scientific judiciousness he omits the biographical dictionary and the testimony of all who know me, and fastens upon a newspaper clipping. That is generally regarded as rather poor scientific evidence; but even so, Mr. Chapman finds it 'illuminating,' and so let us examine it such as it is.

The *Transcript* article professes to be written by a friend of mine, an intimate acquaintance, who was a classmate at Andover Seminary, and who recounts certain occurrences in the class-room as an eye-witness. As a matter of fact, I do not know the man, and never saw him to my knowledge. He was never in the class-room with me, nor in the seminary during my three years' residence. The striking incident which he relates of me happened to another fellow, on the subject of Greek exegesis. He evidently got hold of it by some rumor, applied it to me, and touched it up with a vivid bit of personal recollection to brighten the effect.

A single bit of his testimony may be considered as typical of all the rest. He represents that I fitted myself for Harvard 'by solitary study,' and missed the supreme importance of freshman year; and, therefore, I have been ever since 'easily tempted to overrate my personal knowledge.' The facts are, that I graduated from the classical course in a good high school, which still regularly fits for college; that I took the full four years' course, classical and scientific, at the Bridgewater Normal School, which required an enormous amount of class work; then followed the Harvard degree, and Andover Theological Seminary, and three years in foreign universities, for all of which I have parchments to show that the work was regular and well done. I have undoubtedly seen more 'solitary study' and midnight oil than is good for a man; but, so far as there is any saving grace in class work and professors and in rubbing elbows with better men, I have had rather more than my share of the covenanted as well as of the uncovenanted mercies of our educational system.

All the rest of the statements are of the same kind. They are, almost without exception, errors, or misrepresentations, or pure inventions.

So these 'illuminating paragraphs,' upon which Mr. Chapman lays such emphasis, are illuminating chiefly in showing the enormous presumption with which a man will rush into print and join in a controversy of which he knows nothing. Incidentally, they may shed a little light upon Mr. Chapman's scientific way of collecting evidence.

As for the observations upon which he throws discredit, if he will read the books he will see instantly that he has misrepresented half the cases which he cites so carelessly. As for the others, the crows that played a game with a china ring, the porcupine that rolled down hill, the ducks that drowned mussels in fresh water—for these, and for every other observation which he discredits, I have more written evidence and more oral testimony from reliable observers than for the woodcock, which has just been considered. If scientists and comparative-psychologists are honestly looking for new facts in the animal world, I have enough to fill several reg-

ular editions of SCIENCE, every one of which is supported not only by my own personal observation, but by the testimony of other honest men whose word can be taken without hesitation.

The question naturally arises, and has indeed been asked with some irritation, why, with all these facts at hand, a man does not write as a scientist and produce his evidence. The answer is threefold: (1) I am accustomed to be believed when I speak. Knowing my subject, and with the evidence of my own eyes before me, it has hardly seemed necessary, for the sake of a few critics who will not believe, to refer to supplementary evidence, of which I have a plenty; to 'cross my throat,' boy fashion, as an evidence of sincerity, and to state after every observation: Mr. So-and-so saw the same thing in Such-a-place; if you don't believe it, ask him. (2) I have gone into the outdoor world as a nature lover, not as a scientist; for recreation, not for work; and my aim, as that of other nature writers, is chiefly to influence other people to go out of doors themselves, and by telling the whole truth, so far as I can see it, to open their eyes to the facts of animal life which the scientist, as well as the vacationist, has overlooked, under the supposition that birds and animals are governed solely by instinct and reflex impulses. And (3) while the scientist deals with laws and generalizations and works largely with species, I have dealt always with individuals, and have tried to understand every animal from moose to woodmouse that I have met in the wilderness.

That birds and animals (and even the insects, especially the solitary wasps and spiders) differ greatly among themselves in individual characteristics and habits, is now beyond a question. Sooner or later science will collect these individual differences and go to work upon new laws and generalizations; but at the present moment when one goes into animal individuality he crosses the borderland of science into a realm where our present laws and classifications apply only in the most general way. Every animal he studies closely is different from every other animal, for nature seems to abhor repetition as she abhors a vacuum. As among men, the differences, which lie deep are much harder to detect than the resemblances, which are mostly on the surface. All the men of a city street are alike from a third-story window, which is nearer than we generally get to wild animals. There are even women who declare that the generalization holds true at a closer inspection —but that is another matter. Two men in dress suits will pass the same general social muster at a dance or reception, and may be indistinguishable across a small room; but it will take some intimate acquaintance to discover that they are as far apart as Beelzebub and Gabriel. And any one who has ever learned to know intimately a litter of pups or a litter of fox cubs will recognize instantly that the same differences in character and disposition which prevail among men prevail also, though in less degree, among the beasts of the field, and are the last things to be discovered.

Though the field is an immense one, and practically unknown so far as wild animals are concerned, there are as yet only a few pioneers scattered over it. The facts are plenty enough, but the observers who have the patience and sympathy for the work are very few, and it will be years before they make any impression upon our general ignorance about birds and animals. It must be said also, of the nature students as distinct from the scientists, that they go into the field for pure love of it, rather than from any desire to make a book, or a theory, or to be enrolled among the discoverers of science. The element of personal taste also is a factor against them; they hate to kill and destroy, to stuff and label and put into a museum.

The ornithologists, for instance—and I have known many of them intimately—have been busy for years making collections of nests and eggs and bird skins; they have determined the range and distribution of species fairly accurately, and have gathered much interesting information as to food and breeding places of our native birds. These are the acknowledged 'scientists' of the bird world; and we have watched their work with interest, though at times with regret at the enormous and un-

necessary amount of killing which generally accompanies their investigation. They deal with species and general habits, and their work, so far, covers little more than the surface of bird life. Meanwhile the individual bird, with his own thoughts and feelings, his own life to live and his own problems to solve, has remained almost unknown till a few nature lovers and students entered the field and, leaving behind the gun and the egg-case and the 'identification of species' as the one thing to seek after, have hidden and watched and followed and loved the bird, and have understood exactly in proportion as they have loved him. The derisive cry of 'interested observer' raised against them by certain professed scientists has no reasonable foundation. No man watches and no man records in any field except he be interested. His observations are valuable exactly in proportion as love impels him to find out about things. Scientist and nature student are both seeking truth, and finding the particular manifestations of truth that they seek after. The difference is something like this, that the ornithologist loves specimens and the identification of species and other superficial things, while the nature student loves birds and the life that is akin to our own. The latter may prove, in the end, to be more scientific than the former.

At present the nature student is simply trying, without prejudice, to understand and record life as he sees it, and asks no scientific consideration beyond that suggested by common honesty and courtesy. When his record is written, his facts may be collected, and the comparative-psychologist, who now knows almost nothing of the life of the wild bird or animal, will then be able to finish the work which the ornithologist only began. Not till then shall we have anything like an edequate picture of bird life; and till then it may be well for critics to remember that truth is a large proposition and, like honesty, is not subject to monopoly.

Since the above article was written, another attack in the same spirit has appeared in Science, by Mr. William Harper Davis, a psychologist, who adds the name of Columbia University to support his claims. My first care, after reading the long article carefully, is to cut out from it all the personal abuse, the gratuitous insults to myself and to certain literary men, the repeated sneers at an honored body of some millions of young people, the satire, the ridicule, the sophomoric egoisms and several other things which have no bearing on the subject in hand, and which ought not to have been permitted to appear in a magazine under the great name of Science. What remains of the article consists, as do the other criticisms, of a few paragraphs of dogmatic assertions, denials and accusations, without a shred of evidence to support them.

Two things, however, may be profitably considered by the readers of Science who have seen this new attack, which is extremely characteristic of all the others:

1. Mr. Davis assures us that his article has no personal or unworthy bias. 'No personal feeling of any sort whatever prompts or accompanies this letter,' he assures us. Now here are a few, out of many such, words and epithets which he applies to certain gentle books and their author, and which, since no personal feeling is involved, are supposed by this scientific critic to be purely scientific and impersonal descriptions: '*Sham, crass, crude, aimless, pitiful, preposterous, ludicrous, false, meretricious, unintelligible, distortions, prejudices, farce, abominations, menace, prostitution, hocus-pocus, ignorance, arrogance, erotic effusion, general incapacity, vicious notions, crass misrepresentations, hopeless confusion, inordinate gullibility, a facile fabricator, an influence for evil, chief of a tribe, hopeless romancer, incapable of reform, type of his species, intellectual anarchist, wild ass, a sad case*'—all these for me. And I pass over as irrelevant, '*nuisance, blatancies, bigotries* and *cocksureness*' as applied to popular education.

Such is the language of this 'impersonal' criticism by a scientist. One can not help wondering what would happen to the unfortunate man who should really stir Mr. Davis out of his scientific calm and cause him to write personalities. Certainly even the present language and style are somewhat different

from that to which we are accustomed in the scientific books and treatises of our acquaintance. In an ordinary person this would be called Billingsgate, and the feeling that produced it might be termed anger, irritation, jealousy, malice, envy, spite, or some other purely personal and unscientific stimuli. Since, however, he has no personal feelings in the matter, it might be well for him, being, as he tells us, a 'technical student of psychology,' to examine himself seriously in order to ascertain what extraordinary mental state it is which, without feelings, causes all the symptoms of intense nervous irritation, and which, in a normal scientist, causes him to write in such very unscientific language. We suspect he has mistaken his symptoms, and that he must revise either his language or his psychology.

2. The one specific case which Mr. Davis mentions and ridicules, and which has been derided also by Mr. Burroughs and one or two other critics of his kind, as showing nothing but my own 'gullibility,' is the case of the orioles' nest. In the case of the woodcock I have already given the kind of evidence which supplements my own personal observations, and which I can produce abundantly to verify every one of my published records of animal habits. The orioles' nest is a somewhat different matter, in that it is not the direct result of my own personal observation. I referred to the nest in a magazine article simply to illustrate, from another's observation, the unexpected recurrence of a rare phenomenon, such as an oriole's fastening two twigs together with a piece of twine, which I had once seen done. Since, however, some readers may have an honest question as to why I should accept such an unusual observation, I submit certain facts which, for obvious reasons, it hardly seemed necessary to publish at the time I referred to the nest in the *North American Review*.

I first noticed the nest hanging in a room where a man lay dying. It was a sad story —but that is no part of the evidence. The dying man was being cared for with infinite patience by a kindly workingman, who was no relation whatever. It was the latter who owned the nest, who had watched it building, and who told me about it, one day, noticing my unconscious interest. After the funeral it was given to me, unexpectedly, in gratitude for certain little kindnesses which I had been able to show to the family and to the dying man, who also knew all about the nest. Every circumstance in the case was such as to preclude any thought of deception, even had there been the slightest ground for such a thing.

The nest itself is, without a question, the work of orioles, and the only possible doubt can be in the matter of the framework. The sticks are not such as a man would choose, and the tree in which it hung is the very last that a man would select for hanging such a framework. It is a huge buttonwood, and no man or boy living could climb out on the slender branch to where the nest was hung. Only a ladder would be possible, and in the whole neighborhood of the nest there was not a ladder found long enough to reach it. When it was proposed to cut it down, in the autumn, an extra long ladder had to be brought from some masons who were repairing a chimney; and this had to be stood almost straight on end before it barely touched the branch. Two men were required to hold the long ladder in place while a third went up with difficulty to cut down the nest. If a man had made the framework for the birds' use, he would certainly, unless crazy, have hung it in a different tree and in a more accessible place. All these external facts, which I have verified myself, point to the whole marvelous structure as the work of birds alone.

At least four persons, two men and two women—all of them honest and trustworthy people—saw the nest at different stages of its construction, and when questioned, separately and unexpectedly, gave substantially the same testimony. I submit the sworn statement of the man beside whose house the nest was built, who watched the work of construction from beginning to end, and who cut down the nest after the birds had raised their young in it and flown away:

I certify that I watched, from beginning to end, the construction of the nest now hanging in Dr. Long's study, and described by him in the *North*

American Review. The nest and framework are wholly the work of the orioles themselves. They tied the three sticks together, with string, in the form of a triangle; they swung this triangle by means of cords below the limb of a buttonwood tree and fastened it there, and then built the nest on their own framework. Beyond the bits of thread and string which they collected about the house, they received no help from any human agency. (Signed) F. G. Leslie.

Stamford, Conn., 25 April, 1904.

Subscribed and sworn to before me this 25th day of April, 1904. E. L. Scofield,
Notary Public.

It is hardly necessary to add that we have here a simple question which can not be ridiculed by the cry of 'hunter's yarn' or 'practical joke,' or befogged by the call for expert testimony. It is not a question of instinct or intelligence or comparative psychology, or anything else to call for experts or trained observation. The question is, whether or not certain birds tied three sticks together and hung them unaided from the limb of a tree. That in itself is a sufficiently wonderful fact; and again I leave it to the readers of Science to say whether or not I was justified in accepting it as reasonable evidence.

Let us hear the conclusion of the whole matter. Here are certain books which, by almost universal consent, are doing good in the world. They arouse not only a love for animals, but an intelligent interest and, if the testimony of hundreds of educators is to be believed, a keen interest to study and understand the animal life about them. They are not stories, but studies, and incentives to study; and if unwittingly they contain any error, the error is bound to be swept away by the very interest in nature study which the books themselves arouse. And here, on the other hand, are a few critics, who, in the name and with the authority of science, condemn the books and warn an innocent public against being deceived by falsehood and inventions. Now what is the scientific explanation of this phenomenon? By scientific I mean simply that which will take into account the facts and, so far as possible, all the facts. The alleged facts brought forward in the criticisms which appeared in Science are seen to be dogmatic denials mixed with considerable error and misrepresentation. Here are certain other facts to be duly considered:

1. The books in question record hundreds of observations, the great majority of which are known to be true. The rest are unusual, and some, indeed, seem incredible. On the other hand, it may be said for the latter that we know very little of the lives of the animals described, and the most striking things recorded are no more incredible than scores of well-authenticated instances of the intelligence of dogs and cats and horses. The only question, therefore, is, can we safely attribute to the wild animal the same individuality that we see in our domestic one? In other words, are the wolf and fox less intelligent than the dog, the black duck less keen than the barnyard fowl, the wild turkey and the grouse of less wit than the chickens, the deer and mountain sheep less resourceful than domestic cattle?

2. The observations recorded in the books in question have been made by an experienced observer who has put himself with much care and patience in the position to see what he describes. It is possible that he has made honest mistakes in his observations; but, on the other hand, those facts which have been most denied, like the woodcock, have been verified by other observers.

3. The author studies the living animal in his native haunts and in every case writes from first-hand knowledge, after long experience and with unusual opportunities for observing the wild creatures. The critics, with far less experience or knowledge of the animals in question, and with different interests, deny the observations on general principles, or on the ground that they have not seen them.

4. The attacks which have been made thus far are mostly ill-tempered and intemperate, as far as possible from the scientific spirit which they invoke. Though written in the name of science, they show none of her careful, painstaking methods; though their professed object is truth, they do not verify their own statements nor prove their accusations. The attacks are generally made by men who have

themselves written less successful books or articles on the same general subject.

5. The critics present denials, dogmatic assertions, negative testimony. Not one particle of positive evidence has yet been presented against the books which are so vigorously condemned. Meanwhile the fact remains that, though six or seven volumes and a score of articles have already been published, only two slight errors have thus far been pointed out, and they were promptly and gratefully acknowledged.

Other facts and considerations will undoubtedly suggest themselves, but perhaps it were well to consider these first in forming one's judgment as to the books and their critics.

WM. J. LONG.

STAMFORD, CONN., May 7, 1904.

[We hope that this discussion will not be carried further.—EDITOR.]

THE METRIC SYSTEM.

TO THE EDITOR OF SCIENCE: The suggestion of Professor W. Le Conte Stevens that a compromise be made between the metric and the British system of weights and measures, making a foot the fourth part of a meter and an inch two per cent. smaller than the British inch, might be a good one if the English-speaking race were to disappear from the earth, and all its tools and its technical literature be destroyed, but as long as that race continues to use its existing tools and books, so long must the inch persist with its present value. His article is useful, however, in showing the impossibility of the general adoption of the metric system in its present form by the people of this country. He well says: "What may be the form taken by legislation in England and the United States, the people can not be compelled to adopt nomenclature that is thrust upon them as a substitute for that to which they have always been accustomed."

WM. KENT.

ICHTHYOLOGY IN THE 'ENCYCLOPÆDIA AMERICANA.'

TO THE EDITOR OF SCIENCE: Referring to Dr. Gill's note on the 'Ichthyology of the Encyclopædia Americana,' I may say that he is quite right in supposing that the proofs of the figures which illustrate my article on fishes were not submitted to the author. Many of these seem to be wrongly named as noted by Dr. Gill.

DAVID S. JORDAN.

SPECIAL ARTICLES.

THE MULTI-NIPPLED SHEEP OF BEINN BHREAGH.*

ON two former occasions† I have had the honor of presenting communications to the academy concerning the multi-nippled breed of sheep on my farm at Beinn Bhreagh, near the town of Baddeck, Nova Scotia.

It will be remembered that in 1889, upon the purchase of some property at Beinn Bhreagh I found myself in possession of a flock of sheep; and that in the spring of 1890, one half of the lambs born upon the place turned out to be twins.

This large percentage of twins led me to examine the mothers of all the lambs with the object of discovering, if possible, some peculiarity that would enable us to distinguish twin-bearing ewes from others.

Upon examining the milk-bags of the sheep a peculiarity was observed that was thought might be significant. Normally, sheep have only two nipples upon the milk-bag, but in the case of several of the sheep examined, supernumerary nipples were discovered which were embryonic in character and not in a functional condition. Some had three nipples in all, and some four. Of the normally nippled ewes 24 per cent. had twin lambs; but of the abnormally nippled 43 per cent. had twins. The total number of ewes, however, was so small (only 51) as to deprive the percentages of much significance. Still the figures were suggestive of a possible correlation between fertility and the presence of supernumerary nipples, and it seemed worth while to make an extended series of experiments to ascertain (1) whether, by selective breeding, the extra nipples could be developed so as to become functional, and (2) whether ewes possessing four functional nipples instead of two would

* A paper read before the National Academy of Sciences in Washington, D. C., April 21, 1904.

† See SCIENCE, Vol. IX., May 5, 1899, pp. 637.

turn out to be more fertile than other sheep and have a larger proportion of twins.

1. In regard to the first point mentioned no difficulty was experienced in developing the embryonic nipples into real functional mammæ yielding milk; and for several years past the ewes born on Beinn Bhreagh (with extremely few exceptions) have possessed four functional nipples.

Of recent years lambs possessing five and six nipples have appeared, and it is obvious that continued selective breeding would ultimately result in the production of a six-nippled variety of sheep.

How far the number of functional mammæ could be increased by selection it is of course impossible to predict; but it is worthy of note that one ewe has been born with four nipples on one side of the body and two on the other; and, as the supernumerary nipples have a tendency to appear in pairs, this probably foreshadows the possibility of an eight-nippled variety.

2. In regard to the second point mentioned the multi-nippled sheep have not proved to be more fertile than normally nippled sheep; and the proportion of twins born has been quite small.

One peculiarity, however, is worthy of notice: The twin lambs, though usually smaller at birth than single lambs, speedily come up to the average of the flock in this respect—so that by autumn there is no substantial difference in weight between the single and twin lambs. The multi-nippled sheep are, therefore, able to rear twins more successfully than normally nippled sheep.

This is an important point, and it suggests the advisability of attempting now—by the elimination of single lambs and the retention of twins for breeding purposes—to produce a twin-bearing stock.

At present the Beinn Bhreagh flock constitutes simply a scientific curiosity, and is of little practical value to the country. I propose to make it of value by engrafting upon it the twin-bearing tendency. In Nova Scotia the winters unfortunately are long, and the cost of winter feeding proportionally great, but the country is otherwise admirably adapted for sheep-raising upon a large scale. The production of a twin-bearing stock would do much to promote this important industry by enabling the farmers to make a double profit upon lambs without additional cost.

The proposed experiments, however, can not be made with a small flock, and the natural increase of the Beinn Bhreagh flock is so slow that many years would elapse before it would be practicable to carry out the plans proposed. I have sought to increase the size of the flock by the purchase of multi-nippled sheep from surrounding farms, but an examination of several thousand sheep has convinced me that it is no longer possible to purchase sheep having the characteristics of the Beinn Bhreagh flock to a useful degree. I, therefore, propose to purchase large numbers of ordinary two-nippled ewes and mate them with Beinn Bhreagh rams—segregating the present flock as much as possible. The multi-nippled lambs born to the normally nippled ewes will enable us to increase the size of the multi-nippled flock beyond its natural increase—and be otherwise beneficial by the introduction of new blood; but the new blood will probably be detrimental to the particular line of selection hitherto pursued and lead to a reduction in the percentage of multi-nippled offspring in that flock.

The present, therefore, seems to be a fitting time to place in the hands of those interested in evolutionary problems, a detailed account of the flock; and I have prepared for private circulation two pamphlets, one entitled 'Multi-Nippled Sheep of Beinn Bhreagh, Living 1903, and Their Known Ancestors,' the other 'Sheep Catalogue of Beinn Bhreagh, Showing the Origin of the Multi-Nippled Sheep of Beinn Bhreagh and Giving all the Descendants Down to 1903.' I have great pleasure in presenting the first copies of these pamphlets to members of the academy specially interested in the subject.

Alexander Graham Bell.

BOTANICAL NOTES.

POPULAR HELPS IN THE STUDY OF THE FUNGI.

It is particularly gratifying to notice the efforts that Professor Kellerman, of the Ohio

State University, is making to help the teachers in the public schools of Ohio to a better understanding of the larger fungi. From time to time he issues a four-page folder under the name 'Mycological Bulletin,' consisting of a little text and a good deal of photographic representation of the species he is describing. We know of nothing like these leaflets elsewhere, and can not too heartily commend this method of popularizing the study of the fungi. When it is remembered that these bulletins cost the subscriber only about a cent apiece one wonders that the subscription list does not include every school teacher in Ohio, to say nothing of those outside of that fortunate state.

FOREST FIRES IN THE ADIRONDACKS IN 1903.

THE United States Bureau of Forestry has issued a circular (No. 26) on the forest fires in the Adirondacks, from which we learn that 'between April 20 and June 8, 1903, over 600,000 acres of timber land in northern New York were burned over' with an estimated loss of $3,500,000. A very dry spring and 'culpable carelessness' were what brought about this great loss. 'Deliberate incendiarism' is charged with no small number of fires, while a few are due to unavoidable accident. The author of the circular says after careful examination that 'fully one half of the fires are due to carelessness caught from locomotives' of the railroads in the forests. It is known that a particular excursion train hauled by two locomotives set almost continuous fires for a distance of ten miles. The burning of brush and other débris, the carelessness of smokers, the failure to extinguish smudges and camp fires contributed to the grand total of carelessness. Many fires were set deliberately, in part by those who resent the formation of private preserves, partly by those who do not like the present timber regulations, partly by those who profit by the labor afforded by fire fighting, some by hunters, some by those who hope thereby to increase the berry crop, or the crop of ginseng, etc. A large map tells the story of destruction and loss better than it can be told by words. The circular should serve to awaken the public conscience, and should result in more effective legislation, and a better enforcement of existing laws.

THE BACTERIOLOGICAL ANALYSIS OF SOILS.

A RECENT bulletin of the Delaware Experiment Station brings out an interesting relation of bacteria to the fertility of the soil. It has long been known that certain bacteria in the soil add to its available nitrogen for plant growth, and now Professor Chester has actually made bacteriological analyses of the soil for the purpose of determining the nitrifying efficiency of its bacteria. In soils containing respectively 4,000,000, 3,130,000 and 250,000 bacteria per gram of dry soil the nitrifying efficiencies were 26.68, 13.75 and 2.13. Professor Chester concludes 'that while zymotic efficiency is generally proportionate to the total number of bacteria present in soil, it is not exactly proportionate.' 'It is not only numbers of bacteria but also kinds which determine the efficiency of a soil.' Further on he says 'there is a possibility that the future will develop some practical means of introducing favorable bacterial forms into the soil, and thus of raising its bacterial potential.' Here is a field for the scientific agriculturist not thought of by our fathers, who, if they knew anything at all about bacteria, regarded them as vermin to be avoided as far as possible, and even now most of us think of 'germs' and 'microbes' as dangerous things to have about. Evidently we have done the tribe of the bacteria an injustice, for it looks as though our crops were dependent upon their presence in sufficient quantity in our fields. Is it possible that the farmer of the future may regularly inoculate his fields before planting to a particular crop? While all this is quite funny, Professor Chester has done a piece of good work, and it is to be hoped that he may have the time and inclination to continue it.

THE STUDY OF OUR MOSSES.

ANY one who has attempted to take up the study of the mosses of his neighborhood must have been impressed with the feeling that there is a crying need of a work on the systematic botany of these pretty plants which

is usable by amateurs and other non-technical bryologists. The general botanist who wishes to know something about all kinds of plants has often felt that there is a needless technicality in the books devoted to the lower plants, and with the single exception of the lichens, the mosses have suffered most of all. Several years ago Professor Grout began work on the descriptive botany of the mosses with the intention of remedying this condition of things, and the result was a handy little elementary manual entitled 'Mosses with a Hand-Lens.' The success of this booklet has encouraged him to undertake a larger book, to which he gives the name 'Mosses with Hand-Lens and Microscope.' Of this, Part I. was published some time last year and was noticed in SCIENCE upon its appearance. Part II. is now in the press, and is to appear about the middle of May. An examination of advanced sheets shows that this is to be still better than the first part. With this book, when completed, the study of the mosses will be little more difficult than that of the flowering plants.

SUMMER BOTANY.

THE seaside laboratories are tempting botanists to vacation work at Woods Hole, Cold Spring Harbor and Vancouver Island, with several more stations yet to be heard from. In the interior the Lakeside Laboratory at Cedar Point (near Sandusky), and the alpine laboratory on Pike's Peak offer to the inlander out-of-door recreation mingled with serious study. There should be little difficulty in determining where to go, in case one wants to get out into the air while at work. The sea always calls some of us, and the mountains too call us with a voice that we can not resist. Down by the sea we may study the strange and beautiful things that grow in the depths; on the mountain side we may study changes in vegetation due to altitude and low temperature. At the seaside we may bathe when we are warm and tired; on the mountain side we cool off in the thin air two miles above sea level, and rest under the fragrant Rocky Mountain pines and fir trees. Wherever we go we may do a little work—possibly a good piece of work; at any rate we may be refreshed physically and mentally, so as to return to our class-rooms and laboratories in September able to do better work there.

CHARLES E. BESSEY.

THE BIOLOGICAL LABORATORY OF THE BUREAU OF FISHERIES AT WOODS HOLE, MASS.

THE laboratory will be thrown open on June 16, and will be at the service of a limited number of investigators, for the study of problems in marine biology, from that date until the middle of September. The occupant of a table will as usual be furnished with the ordinary apparatus and reagents and with material for research free of charge. Certain of the steam and other vessels of the bureau will be at the disposal of the laboratory, and systematic collecting will be in progress during the entire season. Candidates for laboratory privileges are advised to submit their applications as early as possible. Those who are not already known at the station will be expected to offer evidence of their qualifications. Applications should be sent to the director, Dr. F. B. Sumner, College of the City of New York, New York, N. Y.

SCIENTIFIC POSITIONS IN THE PHILIPPINE ISLANDS.

THE Civil Service Commission announces that on June 1–2, 1904, examinations will be held for the positions named below in the Bureau of Government Laboratories at Manila, P. I.

Pathologist	$1,800
Pharmacologist	1,800
Chemist, Analytical Division, soils and waters	1,600
Chemist, Economic Products Division, familiar with organic chemistry, essential oils, etc	1,600
Chemist and collector, Economic Products Division	1,500
Assistant for physical chemist	1,500
Entomologist	1,400
Bacteriologist of Serum Division	1,400

These salaries represent the lowest salaries for entrance into the Bureau and it is the plan, as far as possible in the future, to bring in new men in the lowest salaried positions,

giving them the opportunity for promotion as those in the higher positions leave or are promoted. In order to show what these higher salaried positions are, a list of the positions now authorized in the Bureau of Laboratories is given:

BIOLOGICAL LABORATORY.

Director, Biological Laboratory	$3,500
Pathologist and investigator	2,750
Pathologist	2,250
Pathologist	2,000
Bacteriologist	1,800
Entomologist	1,800
Bacteriologist	1,500
Assistant bacteriologist (two)	1,200

CHEMICAL LABORATORY.

Chemist and investigator	2,500
Chemist, Economic Products Division	2,250
Analyst	2,000
Botanist	2,000
Physiological chemist	1,800
Assayer	1,800
Chemist (two)	1,600
Analyst	1,600
Chemist	1,500

SERUM LABORATORY.

Director, Serum Laboratory	3,000
Assistant director	2,500
Veterinarian	1,600
Assistant	1,400
Assistant bacteriologist	1,500

Vacancies are liable to occur in this list, and the employees who are at present in the bureau, if fit for the work, will, step by step, be promoted as the opportunity arises. Energetic young men who are willing to work up in the service are desired. Colleges and universities which are able to train properly qualified men are requested to submit lists of candidates each year so that a sufficient number of names may always be on hand. Facilities for all classes of work will be of the best, and an adequate library will be available.

THE CAMBRIDGE MEETING OF THE BRITISH ASSOCIATION.

As we have already reported the British Association will meet this year at Cambridge, under the presidency of the Honorable A. J. Balfour, the British premier, from August 17 to 24. We take from *Nature* the following facts in regard to the meeting:

In 1833, the third year of its existence, the association met at Cambridge under the presidency of Professor Adam Sedgwick; Sir J. F. W. Herschel presided over the second meeting in 1845, and the third Cambridge meeting was held in 1862 under the presidency of Professor Willis.

The sectional meetings will in most cases be held in the buildings of the several science departments. The sections are the following: A, mathematical and physical science, president, Professor Horace Lamb, F.R.S.; B, chemistry, president, Professor Sydney Young, F.R.S.; C, geology, president, Mr. Aubrey Strahan, F.R.S.; D, zoology, president, Mr. William Bateson, F.R.S.; E, geography, president, Mr. Douglas W. Freshfield; F, economic science and statistics, president, Professor William Smart; G, engineering, president, Hon. Charles A. Parsons, F.R.S.; H, anthropology, president, Mr. Henry Balfour; I, physiology, president, Professor C. S. Sherrington, F.R.S.; K, botany, president, Mr. Francis Darwin, F.R.S.; L, educational science, president, the Right Rev. the Lord Bishop of Hereford.

A 'Handbook to the Natural History of Cambridgeshire' specially written for the meeting under the editorship of Dr. J. E. Marr and Mr. A. E. Shipley, will be published by the University Press; the syndics of the press have decided to present a copy to each ticket-holder, provided that the number to be supplied for the purpose does not exceed 2,000 copies. A special edition of Mr. J. W. Clark's 'Guide to the Town and University' will be presented to each member of the association, also a series of excursion guides, together with a colored map of East Anglia supplied by the director-general of the ordnance surveys.

Emmanuel College has agreed to entertain the secretaries of sections. The majority of the colleges have expressed their willingness to entertain free of charge a limited number of distinguished guests, and some of the colleges have agreed to place rooms at the disposal of members of the association, making a charge for meals and attendance. Girton and

Newnham Colleges, and the Ladies' Training College, have also agreed to extend hospitality and lodging accommodation to British and foreign visitors.

A considerable number of favorable replies have been received in answer to invitations issued to American and foreign men of science; it is expected that at least 100 visitors from abroad will be present.

The master and fellows of Trinity College have granted the use of the college for a conversazione and reception to be held on Thursday, August 18. The Lord-Lieutenant of Cambridgeshire and the Mayor of Cambridge will entertain the members and associates at a garden-party in the Botanic Garden on Monday, August 22. The High Sheriff of Cambridgeshire has also expressed his intention of giving a garden-party during the meeting. On Friday, August 19, a garden-party will be given by the principal of Girton College, and on Tuesday afternoon, August 23, members of the association will be entertained at Newnham College.

It is hoped that a *table d'hôte* lunch will be served on week-days in certain college halls. Light refreshments will be served each day (including Sunday) in the Masonic Hall, adjoining the museums and close to the reception room, from 12 to 8 P.M. It has also been arranged to have an open-air café and beer-garden on ground adjoining the museums, which will be open on week-days from 11 to 6.

The committee has provisionally arranged eleven excursions for Saturday, August 20. These include Audley End and Saffron Walden, Brandon and Didlington Hall (flint-knapping industry and Lord Amherst's collection of Egyptian antiquities), Cromer (geological), the Dykes of Cambridgeshire; Ely, Hatfield and St. Albans, Lincoln, Lynn, Castle Rising and Sandringham, Norwich, Wicken Fen, Wisbech and Woad Works.

On Thursday afternoon, August 18, the registrary of the university, Mr. J. Willis Clark, will deliver a lecture on 'The Origin and Growth of the University.' The evening lecture on Friday, August 19, will be on 'Ripple-marks and Sand-dunes,' by Professor George Darwin, and on Monday, August 22, the second evening lecture will be delivered by Professor H. F. Osborn, of New York, who will give an account of 'Recent Explorations and Researches on Extinct Mammalia.' On Saturday, August 20, Dr. J. E. Marr will lecture to the operative classes on 'The Forms of Mountains.'

A classified list of lodgings and hotel accommodation is now being prepared for the use of intending visitors. Information in regard to lodgings may be obtained from Mr. A. Hutchinson, Pembroke College. General inquiries should be addressed to the local secretaries, British Association, or to Mr. A. C. Seward, Emmanuel College, Cambridge.

SCIENTIFIC NOTES AND NEWS.

Dr. John M. Clarke, paleontologist of the state of New York, has been appointed by the regents of the University of the state of New York to succeed Dr. Frederick J. H. Merrill as geologist and director of the State Museum.

Dr. F. S. Earle, assistant curator of the New York Botanical Garden, has resigned to accept the office of director of the new agricultural station in Cuba. The station will occupy a farm and buildings at Santiago de la Vegas, about twelve miles from Havana. The sum of $75,000 has been appropriated for the establishment and maintenance of the station for the first year.

Dr. Herbert Haviland Field, director of the Concilium Bibliographicum, has been elected an honorary member of the Leipzig Society of Naturalists.

Sir Guilford L. Molesworth has been elected president of the British Institution of Civil Engineers.

Professor V. L. Kellogg, head of the department of entomology of Stanford University, will spend the greater part of next year in Germany, Italy and England.

Dr. M. P. Ravenel and Dr. Leonard Pearson, of the University of Pennsylvania, are about to go to Italy to undertake researches on tuberculosis in the laboratory of Professor Maragliano, at Genoa.

Dr. R. Hoernes, professor of geology in the University of Graz, has been sent by the

Vienna Academy of Sciences to Macedonia to study the earthquake of April 4.

MR. PERCY LONGMUIR, of University College, Sheffield, has been appointed junior assistant in the metallurgical department of the British National Physical Laboratory.

As we have already noted, General Bassot has been appointed director of the observatory at Nice in the room of the late M. Perrotin. M. Simonin has been appointed sub-director of the observatory.

PROFESSOR H. C. PARKER, of Columbia University, lectured before the Geographical Society of Philadelphia on May 4, his subject being 'Mountaineering in the American Alps.' The Elisha Kent Kane medal of the society, awarded to Captain Robert F. Scott, R.N., commander of the *Antarctic* in its recent expedition to the polar regions, was accepted on his behalf by Wilfred Powell, Esq., British consul at Philadelphia.

PROFESSOR W. S. FRANKLIN, of Lehigh University, lectured before the Electric Club of Pittsburg on the 'Electron Theory' on May 2.

PROFESSOR FRANCIS E. LLOYD, of Teachers College, Columbia University, lectured before the American Philosophical Society, on May 6, on 'The Vegetation of the Island of Dominica.' Professor Lloyd spent the summer of 1903 in a botanical exploration of the island.

DR. J. A. EWING, director of naval education, formerly professor of mechanism and applied mechanics in the University of Cambridge, has been appointed Rede lecturer for the present year.

THE certificate of incorporation has been filed of the Walter Reed Memorial Association for the purpose of securing funds to erect a monument in Washington City to the memory of the late Walter Reed, major and surgeon U. S. Army. Dr. Daniel C. Gilman is president, and General George M. Sternberg, vice-president of the association.

THE trustees of the British National Portrait Gallery have received by bequest from the late Mr. Herbert Spencer a portrait of himself, painted by J. B. Burgess, R.A., and a marble bust of himself by Sir J. E. Boehm, R.A. The trustees have purchased a portrait of Sir Isaac Newton, painted as a young man and attributed to Robert Walker.

A COMMITTEE has been formed with the object of collecting subscriptions for the erection of a memorial to James Watt in Greenock, the place of his birth. The site of the house in which Watt was born is the property of the corporation of Greenock, and is placed at the disposal of the committee. The form of memorial will depend on the amount of money collected.

PROFESSOR MAXWELL SOMERVILLE, who occupied the chair of glyptology at the University of Pennsylvania and was a well-known authority on gems, has died at Paris, at the age of seventy-five years.

M. EMILE DUCLAUX, professor of physics and meteorology in the Agricultural Institute at Paris and member of the Academy of Sciences, has died at the age of sixty-four years.

WE regret also to record the death of Professor Moritz Staub, of Buda Pesth, secretary of the Hungarian Geological Society.

THE Civil Service Commission announces an examination on June 4, to secure eligibles to fill a vacancy in the position of chemist in the Bureau of Chemistry of the Department of Agriculture in connection with the inspection of foreign food products, at a salary of $2,000 per annum, and vacancies in the position of chemist of like character, in equal or lower grades, as they may occur in that department.

PRESIDENT ROOSEVELT has decided that the new buildings of the Department of Agriculture shall be built facing the park way that the park commission has recommended to extend through the Mall.

MR. CHARLES H. STERNBERG, of Lawrence, Kans., is prepared to send on approval collections of the reptiles and fishes of the chalk of Kansas.

A MASSACHUSETTS Zoological Society was incorporated last week with a view to establishing a Zoological Park in Boston. The park will be situated in the Stony Brook Reservation, and it is hoped that from $100,000 to

$200,000 will be collected and that work will be begun a year hence. The incorporators are Dr. Charles Sedgwick Minot, president; John E. Thayer and Dr. Henry P. Bowditch, vice-presidents; Dr. Edward G. Gardiner, secretary; Rev. James Eells, treasurer; Outram Bangs, Alexander Pope, William Lyman Underwood and the president and secretary, executive committee; Robert A. Boit, William F. Beal, Rev. Samuel A. Eliot, Hon. John D. Long, Robert M. Burnett, Samuel Hooper Hooper, Professor E. L. Mark, Dr. Samuel J. Mixter, Professor Edward S. Morse, Frederick Law Olmsted, Hon. Herbert Parker, John C. Phillips, Dr. Morton Prince and Professor William T. Sedgwick.

It is stated in *Nature* that a provisional program of the meeting of the International Association of Academies, to be held in London, has been sent to the delegates. On Tuesday, May 24, the commission inquiring into the anatomy of the brain will probably meet at Burlington House in the morning. In the evening the delegates will be entertained by the Royal Society at a banquet at the Whitehall Rooms. Wednesday, May 25, and the morning of the following day will be devoted to the business of the assembly. The king has expressed his wish, if his engagements will permit, to receive the delegates, and it is hoped that arrangements may be made for this event in the afternoon of May 26. On Friday evening, May 27, the delegates are invited to a reception by the University of London; and on the afternoon of May 28 it is proposed to pay visits to the universities of Oxford and Cambridge. On Monday, May 30, the Lord Mayor of London will entertain the delegates at a banquet at the Mansion House.

At Thurlow-park, Norwood, on March 17, Sir Hiram Maxim gave, as we learn from the London *Times*, a demonstration of his new 'Captive Flying Machine.' To a central vertical shaft, over 60 feet high, are attached ten long radial arms, supported by steel wire ropes, and from the ends of these arms are slung cars, each carrying six or eight passengers, and made in the shape of fish or any other form that fancy may dictate. Each is provided with an aeroplane, and by the varying of an angle, and consequently of the lifting power, of this they can, when the peripheral speed is high enough, be made to move up and down and perform complicated evolutions in the air. The speed was not great enough to bring the aeroplanes into action; exigencies of space made it necessary for the cars to be hung about forty feet from the ground, and the diameter of the circular path they followed was so small that sufficient speed to affect the aeroplanes would have been accompanied by an undue development of centrifugal force, owing to increased speed of rotation. The machine, however, is destined for Earl's-court Exhibition, where it will be erected in the middle of the lake; and there the cars will be hung much lower, and with a large circle of travel the peripheral speed will be high enough to bring the aeroplanes into play with a very moderate number of revolutions a minute. The central shaft is driven by a gas-engine, which can turn it at such a rate that the peripheral speed of the cars becomes about sixty-five miles an hour, and they are forced out at an angle of nearly 80 degrees to the vertical; but at Earl's-court the highest possible speed will be 35 miles an hour. A still larger machine is being built for the Crystal Palace, and as the space there is not limited the circle round which the cars travel will be so large that their speed will be high with only four revolutions a minute. In building these machines Sir Hiram Maxim's main object is, not to provide the frequenters of places of amusement with a new sensation, but to defray the cost of serious experiments in aeronautics. He feels certain that the time has now come when it is practicable to make a flying machine that can not fail to be of enormous value to the country as a military engine, and by the aid of the attractions of these captive flying machines at Earl's-court and the Crystal Palace he hopes to obtain from the public enough money to carry his experiments to a successful issue.

In order to promote uniform food standards and a uniform and just government control for the manufacture and sale of foods, there will be held at the St. Louis Exposition an International Pure Food Congress during the

week of September 26 to October 1, 1904. It is proposed to make this a congress of officials in charge of the enforcement of laws that control the purity of food products, of chemists conducting investigations of food products, of manufacturers and dealers in foods, and of all persons engaged in the preservation and distribution of food products. The topics for discussion will be: (1) Adulteration, misbranding and fraud in the sale of food and drink products. (2) The practical problems connected with the preservation, packing and distributing of the different food and drink products. (3) The use of antiseptics and coloring matters in foods and their effect upon the health. (4) Uniform standards for the quality and strength of dairy, food and drink products. (5) Uniform state, national and international laws to control the adulteration of foods, and fraud in the sale of foods, and the best methods for enforcing these laws. (6) Methods of analysis for the detection of food adulterants. (7) To expose such specific adulterations and frauds as may be brought to the attention of the congress, and to recommend methods for suppressing and controlling them. All inquiries concerning the congress should be addressed to R. M. Allen, Secretary, International Pure Food Congress, Lexington, Kentucky.

A SOUTH AFRICAN correspondent writes as follows to the *Observatory:* "I have never come across any mention in an astronomical periodical of Carlyle's few remarks on astronomers, or of the fact that he was once a candidate for the directorship of the Edinburgh Observatory. It seems that this position was in the gift of Jeffrey of *Edinburgh Review* fame, and Jeffrey and Carlyle were intimate friends. Carlyle asked for the position, and was gruffly refused it by nearly the return post. Jeffrey appointed his secretary, whom Carlyle calls 'his taciturn friend with the blear eyes.' Who this was the writer knows not. Carlyle is good enough to say that Jeffrey's nominee did 'well enough.' Carlyle met Airy once—'a hardy little figure, of edacious energetic physiognomy, eyes hard, strong, not fine.' He met Legendre, whose Geometry he had translated in Edinburgh. He was also touched by the hem of Laplace's garment, thus:—"At a meeting of the *Institut* I saw and well remember the figure of Trismegistus Laplace; the skirt of his long blue-silk dressing gown (such his costume, unique in the place, his age and fame being also unique) even touched me as he passed on the session's rising. He was tall, thin, clean, serene, his face, perfectly smooth as a healthy man of fifty's, bespoke intelligence keen and ardent, rather than deep or great. In the eyes was a dreamy smile, with something of pathos in it, and perhaps something of contempt."

THE following circular letter has been sent to English-speaking scholars by the rector of the University of Turin and the chief librarian of the National Library:

> The commotion raised by the disaster of the National library of Turin, and the deep expressions of sorrow presented to it by the most eminent scientific bodies of every civil state, encourage us to address ourselves to the most illustrious of their members; whose studies are in accordance with the sections of the library that have been destroyed and of which sections it is our moral duty to endeavor the reconstruction in their most minute details.
>
> Now since you are a worthy representative of this eminent scientific body and the studies you profess and cherish belong just to the sections destroyed, so we dare hope that in accordance with the joint solidarity which bounds together all the scholars of the world, you will favor and honor our library with the gift of your most esteemed books, which would be even more valued if adorned with an autographic dedication which would remind the studious of your generous present in a moment so painful for the studies.
>
> This request that we have the honor to forward to you is entirely our personal and does not belong to the institution we represent, happy as we are of having an opportunity of so giving public homage to your high scientific attainments in conferring a benefit to the studies.

UNIVERSITY AND EDUCATIONAL NEWS.

THE corporation of the Massachusetts Institute of Technology has instructed its executive committee to confer with the Harvard University authorities on the subject of closer relations between the two institutions.

Wilson College, situated near Chambersburg, Pa., has received a bequest of $40,000 from the late John Lortz, to be used for the erection and maintenance of a natural science building.

Columbia University has received a gift of $60,000 from Mr. Horace W. Charpentier, A.B. ('48), for the chair of pediatrics.

Purdue University has dedicated an assembly hall, erected at a cost of $70,000, the gift of Mrs. Eliza Fowler.

The University of Leipzig has received from the estate of the late Herr Puschmann, 500,000 Marks for the study of the history of medicine.

A liquid-air plant will probably be installed in the basement of the Ryerson Physical Laboratory, of the University of Chicago, during the coming summer, at a cost of about $1,400.

The Chemical Laboratory of the Rensselaer Polytechnic Institute, at Troy, N. Y., was damaged by fire on the night of May 6. It is said that the fire was caused by an explosion of chemicals and that the loss amounts to nearly $75,000.

The British Chancellor of the Exchequer recently promised a deputation that the treasury grant to university colleges should be raised from £25,000 to £50,000 a year, and held out some hope that the sum might be raised to £100,000 next year. The following committee has been appointed to report on the allocation of the proposed increased grant: The Right Honorable R. B. Haldane, M.P. (chairman), Sir F. Mowatt, G.C.B., I.S.O., Mr. C. A. Cripps, K.C., M.P., the Rev. Dr. Woods, late president of Trinity College, Oxford; Mr. Henry Higgs, of the treasury, will act as secretary.

By a recent decree of Queen Wilhelmina the University of the Netherlands will recognize hereafter the degree of Bachelor of Arts from the following American institutions: The University of California, Catholic University of America, University of Chicago, Clark University, Columbia University, Cornell University, Harvard University, Johns Hopkins University, Leland Stanford Junior University, University of Michigan, University of Pennsylvania, Princeton University, University of Wisconsin and Yale University.

The trustees of Stanford University adopted on March 31 a form of organization which appears to differ from that of most universities by the creation of an advisory board. This consists of nine members, three being elected each year by the academic council or general faculty. All executive acts of general importance, including recommendations for appointments, promotions or dismissals, are to be submitted by the president to the advisory board for approval before they become operative or before they are submitted to the trustees for action, when such action is necessary.

A vacation course in geography, similar to that of August, 1902, will be held at the Oxford School of Geography during the first sixteen days of next August, provided that a sufficient number of students send in their names. It is proposed to have courses of lectures, probably on the British Isles and on the principles of geography applied to education, and in addition to have classes for practical work both in and out of doors.

Professor Albert W. Smith, of Stanford University, has been appointed director of Sibley College, Cornell University, succeeding the late Robert H. Thurston.

Miss Bertha May Clark, of Baltimore, holder of a foreign fellowship from the Woman's College of Baltimore, has been awarded the annual fellowship given by the Baltimore Association for the promotion of the University Education of Women. Miss Clark graduated from the Woman's College in 1900, was the holder of a graduate scholarship at Bryn Mawr College in 1900–1901, and was afterwards instructor in physics in the Woman's College of Baltimore.

Dr. Henry H. Dixon, who has been assistant to Professor Wright since 1892, succeeds him as professor of botany in Trinity College, Dublin.

Erratum: The note on page 774 of the last issue of Science should read "Johns Hopkins gives opportunity for professional work in connection with the Geological Survey of Maryland."